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EARTHQUAKE ACTIVITY AND ANTECEDENT UFO REPORT NUMBERS

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Summary.—Statistical analyses were conducted to test the model that a discriminable portion of luminous phenomena now classified under the gross rubric of UFOs (unidentified flying objects) are coupled with tectonic strain-seismic activity. Various correlational methods involving over 20,000 UFO reports between 1951 and 1965 for six earthquake sectors of the U.S.A. indicated that the combined numbers of seismic events during 6-mo. periods within the northeastern, eastern and central regions were correlated as much as 0.70 with UFO report numbers during *previous* 6-mo. intervals (UFO report-seismic event lag $= -1$). Other lags as well as correlations with total U.S.A. seismic numbers were not statistically significant. Several specific statistical evaluations were completed.

Transient, luminous displays with odd geometries and kinetics have been called UFOs (unidentified flying objects) or a related metaphor (Persinger, 1976). Despite statistical analysis demonstrating that some of the variability in numbers of UFORs (UFO reports) is subject to demographic variables (Saunders, 1975), the stimulus sources for many UFORs are still unclear. The dilemma has been antagonized by many difficulties, including the absence of quantitative and testable models.

Although confounding factors from human behaviors, such as labeling artifacts and memory modifications (Persinger, 1979a), remain a persistent source of variance in numbers (and details) of UFORs, a geophysical stimulus may account for a significant portion of their variability. This factor appears to be related to some unspecified mechanism coupled with tectonic strain or seismic activity. UFO-like phenomena induced by this mechanism would be qualitatively similar to the displays of varied luminous shapes, diffuse glows, and related light stimuli that have been associated with some earthquakes for centuries (Derr, 1973; Finkelstein, Hill, & Powell, 1973; Terada, 1931; Yasui, 1971).

The general assumption of the model is that normal geophysical forces usually (and inconspicuously) applied over large areas are transiently localized in time (1 to 100 min.) and space ($100m^2$ to 1 km^2). Whereas more intense localizations evoke measurable seismic events, less intense occurrences (with no evident fracturing) would produce various transient electromagnetic phenomena. The particular manifestation, such as thermoelectric or piezoelectric effects, would depend upon the local geochemistry and architecture.

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Qualitative predictions generated from this model concerning the expected luminous potentials, movement dynamics, shapes, and geographical areas of occurrence for these phenomena are commensurate with UFO report histories (Persinger, 1979b). Expected biobehavioral consequences from close proximity would range from apprehension to direct effects upon the nervous system (Persinger, 1975). The oddity of the phenomena would lie primarily in the manner in which they are perceived and interpreted rather than in the general principles involved.

To evaluate this model further, several predictions previously generated (Persinger & Lafrenière, 1977) were tested against available data. (1) If UFORs are associated with accumulating tectonic strain, then reports should increase more often before seismic events. (2) Areas typified by histories of slow accumulation of strain and/or decades of predominately low magnitude quakes (≤ 4 Mercalli), such as the central U.S.A., should demonstrate the highest correlations between numbers of seismic events and numbers of UFORs. (3) Low level (Mercalli 4 or less) seismic events should be more correlated with UFOR numbers than more intense quakes, especially if the latter events are followed by massive structural rearrangements and stability.

The monthly total tallies of UFO reports from 1950 to 1970 for each of the six major seismic sectors (see Coffman & von Hake, 1973, for specific states) of the continental U.S.A.: northeastern (NES), eastern (EAS), central (CEN), western mountain (WMT), California-Nevada (CAN), and Washington-Oregon (WOR), were obtained from the Center for UFO Studies (Evanston, Illinois) data file: UFOCAT. Monthly total tallies for earthquakes, less than or equal to Mercalli IV or above this value were obtained for each sector from the yearly publications of United States Earthquakes published by the U.S. Department of Commerce and from Coffman and von Hake (1973).

Initial analysis of the UFOR data indicated a disparity in the mean numbers of UFOR and distribution characteristics after 1965, a factor that may be related to a change in data sources. Consequently, all data analyses were confined to the years 1950-1965. This involved the following numbers of total UFORs (in parentheses) for the six sectors: NEA (2,477), EAS (4,769), CEN (7,506), WMT (2,072), WOR (800), and CAN (2,853); total (20,477). The total numbers of seismic events listed were: NEA (55), EAS (87), CEN (126), WMT (979), WOR (140), and CAN (1,888).

Since the analysis increment has been shown to be a critical factor for the discrimination of possible UFOR-seismic correlations (Persinger & Lafrenière, 1977), UFOR and seismic data were calculated according to 1-, 3-, and 6-mo. intervals, Pearson-product correlation coefficients were calculated by computer using SPSS programs for UFO data (1950-1964) lagged from one year before to one year after the seismic events (1951 to 1965), for all six sectors.

As internal data checks, scattergrams were generated for all correlations and visually inspected for extreme values and non-linearities. Descriptive statistics indicated some possible anistropic measures of skewness and variability for seismic events in the WMT and CAN sectors. As an extra precaution against extreme points, all UFOR numbers and seismic numbers were partitioned according to low, medium and high categories (3×3 matrix). Nonparametric analyses (chi-squared, Kendall's *tau*) were performed on these ordinal arrangements.

As can be seen in Table 1, the largest correlation coefficients (about 0.7) between UFO reports and seismic events occurred with the 6-mo. intervals. The most significant correlations occurred between CEANE seismic events (sum of EAS + NEA + CEN) and total UFO reports from the total U.S.A. and CEN sector during the previous 6 mo. (lag = −1). All other correlations (lag = −2, 0, 1, 2) with these measures and with total earthquakes were not significant statistically. A scattergram of the statistically significant lag is shown in Fig. 1.

Three-month intervals (Table 1) also demonstrated the most significant correlations ($r = 0.40$) between CEANE quakes and UFO measures during

TABLE 1

LAG CORRELATIONS FOR THREE- AND SIX-MONTH INTERVALS BETWEEN CEANE AND TOTAL (QUATO) U.S.A. EARTHQUAKE NUMBERS AND CENTRAL (CEN) AND TOTAL (UFOTO) UFOR NUMBERS FOR 1951-1960 AND 1951-1965

Lag	CEANE vs UFOTO	CEANE vs CEN	QUATO vs UFOTO	QUATO vs CEN	Lag	CEANE vs UFOTO	CEANE vs CEN	QUATO vs UFOTO	QUATO vs CEN
				Six-month Intervals					
	1951-1960 ($n = 20$)					1951-1965 ($n = 30$)			
−2	−0.18	−0.16	−0.23	−0.06	−2	−0.08	−0.09	−0.14	0.01
−1	0.79§	0.80§	0.17	0.09	−1	0.69§	0.71§	0.20	0.13
0	−0.00	−0.22	0.03	−0.22	0	0.14	0.01	0.08	−0.10
+1	0.23	0.26	0.16	0.18	+1	0.19	0.13	0.15	0.13
+2	−0.25	−0.35	−0.21	−0.16	+2	−0.11	−0.22	−0.19	−0.15
				Three-month Intervals					
	1951-1960 ($n = 40$)					1951-1965 ($n = 60$)			
−4	0.16	−0.10	0.00	0.06	−4	0.15	−0.10	0.06	0.06
−3	0.02	−0.03	−0.08	−0.09	−3	0.05	0.01	−0.02	−0.05
−2	0.45†	0.40†	0.11	0.05	−2	0.41†	0.35†	.13	0.08
−1	0.57‡	0.56‡	0.24	0.16	−1	0.42†	0.41†	0.21	0.14
0	−0.03	−0.14	0.08	−0.09	0	0.10	0.03	0.09	−0.05
+1	−0.09	−0.17	−0.21	−0.28	+1	−0.03	−0.12	−0.14	−0.20
+2	0.17	0.23	0.00	−0.01	+2	0.19	0.17	0.01	−0.00
+3	0.06	0.09	0.25	0.38*	+3	0.07	0.03	0.22	0.29*
+4	−0.21	−0.24	−0.17	−0.12	+4	−0.11	−0.16	−0.16	−0.12

*$p < 10^{-2}$.
†$p < 10^{-3}$.
‡$p < 10^{-4}$.
§$p < 10^{-5}$.

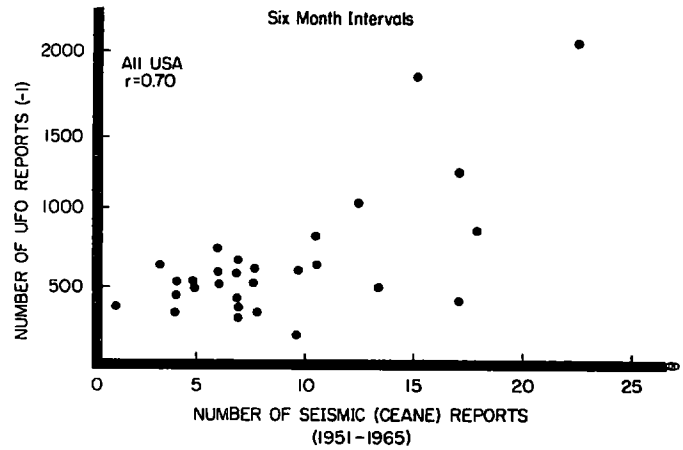

FIG. 1. Scattergram for the correlation between the numbers of seismic reports in the CEANE region during 6-mo. intervals and the numbers of UFO reports (UFORs) in the continental U.S.A. (not including Alaska) during previous 6-mo. intervals (Lag = −1, i.e., UFO data lagged one 6-mo. increment before earthquake data)

the previous 6 mo. (lags = −1 and −2 for these intervals). Analyses of 1-mo. intervals showed similar but marginally significant trends. Total seismic events for all the U.S.A. did not display significant correlations with UFORs in any sector or with total UFORs.

To determine the reliability of these patterns within the data, correlation coefficients (r) were calculated between UFORs lagged 1 interval (−1) behind the seismic events for each of the six sectors. To test specifically the magnitude component of the hypothesis separate correlations were calculated for seismic events $\leq$ 4 Mercalli and for events $\geq$ 5 Mercalli. The results are presented in Tables 2 and 3.

TABLE 2

CORRELATION COEFFICIENTS BETWEEN NUMBERS OF SEISMIC EVENTS $\leq$ 4 ON MERCALLI SCALE WITHIN DIFFERENT EARTHQUAKE SECTORS OF U.S.A. AND NUMBER OF UFO REPORTS IN THESE SECTORS DURING PREVIOUS SIX-MONTH INTERVALS FOR 1951-1965

Seismic Reports $\leq$ 4 M	UFO Reports (Lag = −1)					
	NEA	EAS	CEN	WMT	WOR	CAN
NEA	0.14	0.35*	0.06	0.15	0.16	0.07
EAS	0.38*	0.26	0.56*	0.48*	0.40*	0.40*
CEN	0.26	0.51*	0.27	0.26	0.43*	0.47*
WMT	−0.37*	−0.11	−0.20	−0.15	0.07	−0.30*
WOR	−0.22	−0.03	0.02	−0.06	−0.08	−0.04
CAN	0.31*	0.35*	0.31*	0.32*	0.57*	0.60*
CEANE	0.58*	0.64*	0.71*	0.62*	0.60*	0.63*
QUATO	0.03	0.20	0.14	0.15	0.43*	0.26

*$p < .05$.

TABLE 3

CORRELATION COEFFICIENTS BETWEEN NUMBERS OF SEISMIC EVENTS ≥ 5 ON MERCALLI SCALE WITHIN DIFFERENT EARTHQUAKE SECTORS OF U.S.A. AND NUMBER OF UFO REPORTS IN THESE SECTORS DURING PREVIOUS SIX-MONTH INTERVALS FOR 1951-1965

Seismic Reports ≥ 5 M	UFO Reports (Lag = −1)					
	NEA	EAS	CEN	WMT	WOR	CAN
NEA	0.13	0.14	0.03	0.16	0.10	0.21
EAS	−0.11	−0.16	0.01	−0.18	−0.13	0.03
CEN	0.34*	−0.16	0.50*	0.09	0.04	0.15
WMT	−0.26	−0.20	−0.22	−0.20	−0.20	−0.38
WOR	−0.14	−0.22	−0.06	−0.03	−0.25	−0.20
CAN	−0.10	−0.01	−0.03	−0.05	0.32*	0.16
CEANE	0.20	0.07	0.32	−0.00	−0.01	0.19
QUATO	−0.19	−0.17	−0.06	−0.16	−0.01	−0.14

*$p < .05$.

The coefficients are compatible with the general predictions. The greatest number of significant correlations occurred with UFORs *before* low level (≤ 4) seismic displays. Although CEANE quakes were correlated significantly with UFO reports in all of the sectors, only the CAN and CEN sectors showed significant correlations between UFORs and seismic events within the sector. Non-parametric correlations demonstrated similar coefficients, the magnitudes of which were reduced by about 0.1 of r values for the ≤ 4 Mercalli events but were *increased* by about 0.1 (0.2 for the CEN and EAS sectors) for the ≥ 5 Mercalli quakes.

However, as expected, the CEANE quakes did show greater correlations with NEA, EAS and CEN UFORs than with UFORs in the WMT or WOR regions; the latter correlations with CEANE and within sector quakes were predominately *negative*. Factor analysis (rotated factor matrix) of total earthquakes for all six sectors indicated two discriminable factors: factor 1, composed of (rs in parentheses: criterion $r \geq 0.40$) the EAS (0.60), CEN (0.50) and CAN (0.71) sectors and a second factor composed of the WMT (0.70) and WOR (0.63). The NEA sector was low on both factors.

Factor analyses of UFORs in the six sectors indicated the existence of only a single factor upon which all sectors were loaded with rs between 0.75 and 0.85. The 36 correlations coefficients between pairs of sectors for UFORs displayed rs between 0.5 and 0.7. The 36 rs among the sectors for total seismic events displayed only two statistically significant relationships between WOR and WMT ($r = 0.42$) and between CAN and EAS ($r = 0.39$). Total seismic numbers in the NEA, EAS and CEN sectors were not significantly intercorrelated.

First-order partial correlations were performed between the different sectors and with the most powerful seismic predictor: CEANE quake numbers.

Partials for CEN UFORs and all UFORs for other sectors with CEANE held constant or with CEANE and each of the other sectors held constant produced no significant alteration in the magnitudes of coefficients. The two major exceptions were: (1) UFORs in the EAS region were correlated 0.50 with CEANE quakes (UFORs controlled) but not with UFORs (0.14) in CEN region (CEANE quakes held constant) and (2) UFORs in the NEA region were correlated with UFORs of the CEN region 0.41 rather than CEANE (−0.02).

The UFOCAT includes a number of different categories based upon *ad hoc* criteria using primarily human verbal behavior. As an internal check of the data Type 1 and Type 2 UFORs (the most numerous type categories) within the six sectors were lagged (6-mo. intervals) with the seismic reports within each sector. Type 1 is described as a stationary UFO with movements not greater than apparent motion of planets (15°/hr.) and Type 2 was described as a UFO with continuous trajectory at speeds greater than 15°/hr. Whereas one significant correlation (EAS, 0.43) for any of the lags was noted for the Type 1 UFORs, as a data group, three significant *within* sector correlations were found for seismic numbers and Type 2 UFORs during the previous 6-mo. intervals in the EAS (0.40), CEN (0.32), and CAN (0.54) sectors.

The data support the crude associations noted between seismic activity and UFORs. Although the variation in numbers of seismic events in the central, eastern, and northeastern sectors of the U.S.A. during 6-mo. periods accounted for no more than about 50% of the variability in UFOR numbers, the magnitude of these effects may be considered significant in light of the gross nature of UFOR measurements. Perhaps we will find that the UFO dilemma, like so many other *apparently*, unsoluble problems in the history of science, can be resolved by precise numerical analyses.

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